# AN EXPERIMENTAL STUDY OF BROWSE AS A WINTER DIET FOR PRAIRIE CHICKEN

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FOOD habits studies begin as lists of what an animal eats, but soon become measurements of the nutritive values of the different foods. Examples of food lists are too numerous and too well known to need mention; examples of nutritive measurements are still scarce. Leopold (1933:258–72) set up a classification of wildlife foods based on preference as a measure of quality; a few others have measured quality directly by bio-assay, particularly for foods of Bob-white (Errington 1931, 1933, 1936), Ring-necked Pheasant (Errington, 1936, 1937), and deer (Maynard *et al,* 1935; Davenport, 1937; Nichol, 1938). Such studies as these seek to answer the question, "Will this food, or that combination of foods, keep this particular animal alive and in good condition?" There is an obvious need, from the standpoint of wildlife management, for direct measurement of the nutritive values of more foods of more animals.

The Prairie Chicken [1] is a case in point. As a member of the grouse family, can it, like most of the others, live through the winter on a diet of browse alone? The issue has been a controversial one for many years.

The question is open to two approaches, one observational, the other experimental.

## Diet: Observational Data

According to Schmidt's (1936) report and the unpublished notes of F. N. Hamerstrom and Frances Hamerstrom, the main winter foods in Wisconsin are:

Grains—corn, buckwheat, soybeans, barley, oats, rye.

Weed seeds—many kinds, such as lesser ragweed (*Ambrosia artemesiifolia*), climbing false buckwheat (*Polygonum dumetorum*), and other members of the same genus, green foxtail (*Setaria viridis*).

Browse—white birch (*Betula alba* var. *papyrifera*), bog birch (*Betula pumila* var. *glandulifera*), hazel (*Corylus americana*), aspen (*Populus tremuloides*), sweet fern (*Myrica asplenifolia*), and blueberry (*Vaccinium pennsylvanicum*) are most heavily used; to a lesser degree, willow (*Salix* spp.), maple (*Acer* spp.), elm (*Ulmus* spp.), pine (*Pinus banksiana, P. resinosa,* perhaps also *P. strobus*), and apple (*Pyrus malus*).

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[1] *Tympanuchus cupido americanus.*

Fleshy fruits and mast—in winter, limited mainly to rose hips (*Rosa* spp.) and acorns (*Quercus* spp.)

Greens—such green leaves as they can get, as dewberry (*Rubus* sp.), clovers, and sometimes grass.

Schmidt (1936) found that the Prairie Chickens he was studying lived almost entirely on buds when the temperature was above zero, but ate, and probably needed, corn at temperatures below zero; the Hamerstroms found Prairie Chickens regularly eating corn and other grains and weed seeds through the autumn and mid- and late winter, but for a time in early winter found them absent from their accustomed grain and weed fields.

It is likewise clear from observation alone that Prairie Chickens are found in greatest numbers in farming regions, not only in Wisconsin but in the North Central States generally. Not in all farming regions, to be sure, for most are now so completely under cultivation that too little cover remains. Too much cultivation has driven Prairie Chickens from most of their original range; too little is having the same effect in parts of their acquired northern range, where areas once open are growing up solidly to brush (Hamerstrom, 1939).

Although Prairie Chickens are found in farming regions and are known to eat grains, it does not follow that cultivated crops are *essential* foods. Farm lands are open lands, and openness is an essential part of Prairie Chicken range. It may even be that good farming soils are good Prairie Chicken soils.

The fact that cultivated fields are used consistently as feeding grounds comes closer to the point. Weed seeds are eaten in quantity, particularly in autumn, but in the northern states cannot be relied upon as winter food because of snow cover. Of the two sorts of winter food, cultivated grains therefore seem to be the more important. This argument is supported by the fact that the Prairie Chickens' southward migration in winter (Cooke, 1888:104–6; Leopold, 1931:173–5) was markedly lessened by the introduction of corn into the northern states (Spurrell, 1917; Swanson, 1940).

On the other hand, we have reports of a few instances in which a few Prairie Chickens winter in places that have little or no winter grain to offer. Our two best authenticated examples are a flock in Oneida County, Wisconsin (Schmidt, 1936), and the Seney Migratory Waterfowl Refuge, Germfask, Michigan (John H. Steenis, 1940, *in litt.*).

## Diet: Experimental Data

Since the observational approach does not present a clear answer, we tried a feeding experiment on captive Prairie Chickens in the winters of 1939 and 1940.

The purpose of the experiment was to determine whether a diet of browse (i.e., buds and catkins) alone, in unlimited quantity and freely selected, could maintain the weight of Prairie Chickens in winter.

Thirty-eight wild Prairie Chickens (22 in 1939 and 16 in 1940) were trapped and sent to the State Experimental Game and Fur Farm

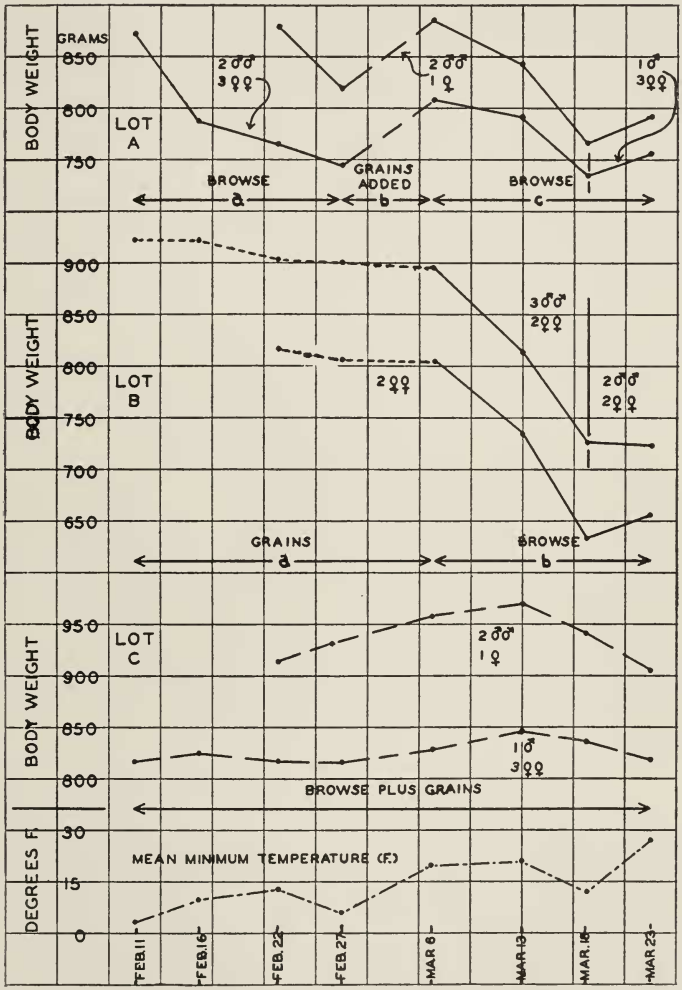


Figure 1. Effect of browse diet on Prairie Chickens, as shown by body weight: 1939.*

* After a bird died during an experiment, the succeeding weights were corrected to permit the weight curves to be unbroken, by adding (or subtracting) average weight changes for the remaining live birds to the average weight of all birds of that lot at the time the individual died.

at Poynette, where they were brailed and held on browse plus grains for seven to ten days to accustom them somewhat to captivity. They were then divided into lots of about eight birds each, half males and half females. Each lot was held in a 12 x 12 foot pen which was open to the weather except for an 18 inch baseboard and a few small shelters, roofed but open to the weather on two sides.

One lot was kept each year on browse plus grains to serve as controls. One lot each year was fed on browse alone, then on browse plus grains, then (in 1939 but not in 1940) on browse alone again. One lot started the 1939 experiment on grains without browse, then was shifted to browse alone. All birds were weighed about every five days, except during the initial holding period.

For details concerning the kinds of browse and the manner of feeding, see below [2]; dates and the exact numbers of birds per lot are given in Figures 1 and 2. Temperature records were provided by the

TABLE 1

Effect of Diet of Browse Alone, as Shown by Body Weight

| Lot | Diet | No. birds | Average Weight per Bird | | | | | Average period of time |
|---|---|---|---|---|---|---|---|---|
| | | | At start | At finish | Max. loss below starting average | Max. recovery | Max. gain above starting average | |
| Aa | Browse | 8 | 89.2% | 78.8% | 10.4% | | 0.0% | 11.9 days |
| Ac | Browse | 8 | 85.4% | 78.6% | 9.2% | 2.4%* | 0.0% | 16.4 days |
| Bb | Browse | 7 | 90.2% | 73.0% | 17.8% | 0.6%** | 0.0% | 16.3 days |
| Da | Browse | 8 | 93.6% | 80.2% | 13.4% | | 0.0% | 10.0 days |
| Average | Browse | 7.75 | 89.6% | 77.8% | 12.5% | 0.7% | 0.0% | 13.6 days |

* 7 birds.
** 6 birds.

[2] Experimental diets:

(a) Browse—(1) white birch, bog birch, hazel, sweet fern, aspen, blueberry, grit; (2) willow, elm, maple, river birch (*Betula nigra*), alder (*Alnus incana*), rose hips and fruiting heads of smooth sumac (*Rhus glabra*). River birch sometimes had to be substituted for white birch in 1939, but white birch was used throughout the 1940 experiment.

(b) Grains—yellow corn, buckwheat, soybeans, oats, barley, wheat, and rye; grit. The straight grain diet was used only in 1939.

(c) Browse plus grains—diets (a) and (b) together.

Grains were hopper fed, each kind in a separate compartment. Browse was fed in the form of cut branches, rather than hopper fed. All kinds of group (1) were before the birds at all times (with the exception noted above), and were replaced with new material at least every ten days and sometimes more often; group (2) plants were fed somewhat less regularly. White birch browse was generally taken from open-grown trees or from the edges of thickets, as a preference for such browse has been noted by Schmidt (1936) and the Hamerstroms (unpub.). Brushy marsh willows were used instead of tree willows.

Hopkins and Rinzel cared for the birds throughout the experiment. Dr. T. T. Chaddock, Departmental Pathologist, Wisconsin Conservation Department, made pathological examinations of the birds which died during the experiment.

U.S. Weather Bureau station at Arlington, Wisconsin, about five miles southwest of the Game Farm.

The effects of the several diets on body weight are shown in Figures 1 and 2. Tables 1 and 2 express the same data on a percentage basis, using weights at the time of capture as the base. (Weight changes for each lot are calculated from the wild weights of its own members, rather than from an average of all birds together.)

Weight losses on browse alone were severe. Two males and one female starved to death, at 63.5 per cent, 58.3 per cent, and 70.1 per cent respectively, of their weights at the time of capture, in five, nine, and 11 days, respectively. More birds would certainly have died, had not grains been added to the browse diet in time.

The two instances of partial weight recovery on browse came during the spring break-up in 1939, at the time of a sharp and marked rise in temperature.[3] It may be that a diet of straight browse is adequate in mild weather, or it is possible that some supplementary food was found on the ground in the pens after the snow melted. In any case, we do not think that this weight recovery has any bearing upon the insufficiency of browse as a *winter* diet.

TABLE 2

Effect of Diets of Grain Alone and Browse Plus Grains, as Shown by Body Weight

| Lot | Diet | No. birds | Average Weight per Bird | | | | Average period of time |
|---|---|---|---|---|---|---|---|
| | | | At start | At finish | Max. loss below starting average | Max. gain above starting average | |
| Ba | Grains | 7 | 92.4% | 90.2% | 2.2% | 0.0% | 19.9 days |
| C | Browse plus grains | 7 | 88.2% | 87.9% | 0.3% | 4.4% | 35.3 days |
| E | | 8 | 88.8% | 85.7% | 3.1% | 1.0% | 43.0 days |
| Average | | 7.5 | 88.5% | 86.7% | 1.8% | 2.6% | 39.4 days |
| Ab | Grains added to browse diet | 8 | 78.8% | 85.4% | 0.0% | 6.6% | 7.0 days |
| Db | | 7 | 81.5% | 86.3% | 0.0% | 4.8% | 15.0 days |
| Average | | 7.5 | 80.1% | 85.9% | 0.0% | 5.8% | 10.7 days |

[3] Temperature for the five day period, March 18–23, during which the recovery occurred: mean 42.6°, maximum 75°, minimum 20°.

A comparison of Tables 1 and 2 shows very clearly that diets including grains are far superior to those without them. By converting the different time periods to uniform periods of two weeks each, the difference may be summarized thus: the birds on browse alone lost an average of 12.9 per cent per bird and three starved to death; addition of grains to the browse diet caused a gain in weight of

7.6 per cent; the birds on grains alone and browse plus grains lost only 1.5 per cent and 0.6 per cent, respectively, of their weights.

This contrast between diets with and without grains would probably have been even greater but for two things:

Infectious disease got into the control pen in 1939. Two males died of disease so early that they were not included in the calculation, and three males died of disease at the end of the experiment. No evidence of disease was found in the other pens. The rather minor weight fluctuations of Lot E (See figure 2) probably give a more accurate picture

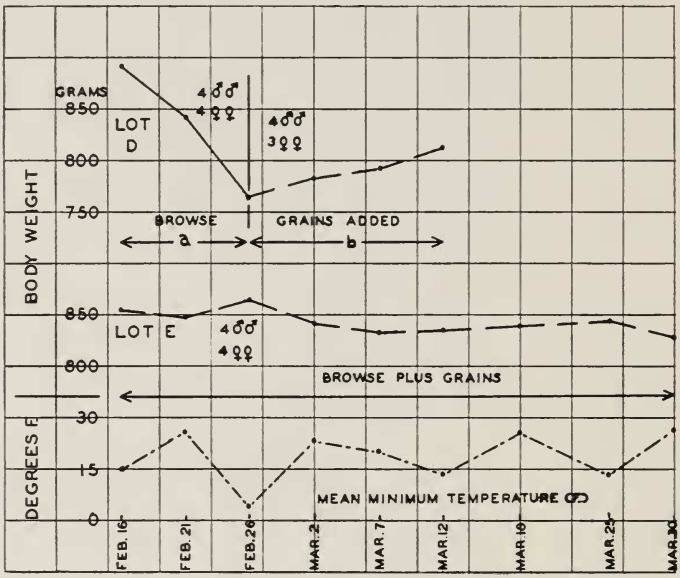


Figure 2. Effect of browse diet on Prairie Chickens, as shown by body weight: 1940.**

than the average of the two control lots. Secondly, the 1940 browse birds (Lot Db) show a poor recovery after the addition of grains, which we suspect is misleading. The females of this lot continued to lose weight during the first five day period of the supplemented diet (from 78.8 to 77.7 per cent), barely held their own during the next period (to 77.9 per cent), and made a slight gain during the last five days (to 80.3 per cent). Examination of sample droppings from this pen showed that very little grain was being eaten by some of the birds—perhaps by the females which did not respond to the change in diet. In contrast, the males of the same lot regained weight in a manner

** See footnote to Figure 1.

comparable to the behavior of the birds in Lot Ab, from 83.1 per cent, when grains were added, to 90.2 per cent at the end of the experiment. Part of the birds in Lot Ab regained slightly more weight after the addition of grains than they had lost on the browse alone (Figure 1).

Whether or not our interpretations of the few discrepancies in the data are correct does not alter the trend, but only—and slightly—the degree, of the main points: birds fed only browse lost weight rapidly, and three starved to death; the addition of grains to the browse diet was followed by a recovery of weight, in some cases to or above the weights at which they started the browse diet; birds on browse plus grains and grains alone practically maintained their weights.

Were these weight changes caused by anything other than differences in the diets? We think not.

The other factors most likely to influence the experiment are probably penning and weather. To pen so wild a bird as the Prairie Chicken introduces an unavoidable difficulty; unavoidable because pen-reared stock was not to be had. Although the birds became considerably tamer during the holding period, the effect of captivity ("penning factor") could not be entirely eliminated; witness the fact that no lot was at any time up to full wild weight. Judging by the behavior of the controls, penning depressed average weights by about 10 to 12 per cent. However, since the details of penning and handling were the same for all lots, it seems reasonable to suppose that the penning factor was the same for all lots, and that direct comparisons in weight behavior may be made among the different lots.

Of the various factors which together make up "weather," temperature is probably the only one which might have influenced weight behavior. The birds were protected against wind by a board wall 18 inches high around the bottom of the pens, and by small board shelters. Snow depth did not affect the food supply. Wild Prairie Chickens often roost under the snow, presumably to conserve body heat. Since the snow within the pens soon became packed down after each new fall, roosting under the snow was generally impossible; this, however, resolves itself into a question of temperature.

The range of winter temperatures included in the experimental periods apparently had not controlling effect on body weight. Between consecutive weighings, weights on browse went down as the temperature rose five times, went down as the temperature lowered four times; after the addition of grains weights went up as temperature went down twice, went up as temperature went up twice. The weight fluctuations of the controls, and of the birds on grains alone, did not at all parallel the weight changes of the experimental birds, either in time or in degree.

The paragraph above refers only to winter conditions. The weight increase at the end of the 1939 experiment has already been discussed.

There seems to be little room for doubt, then, that the weight changes in the experiment were due to diet—that browse alone is inadequate, and leads, at least in some cases, to death by starvation. We do not believe that the data are extensive enough to warrant more detailed analysis—rates of loss and recovery, and differential sex behavior, for example.

How closely the insufficiency of the experimental browse diet may be translated to conditions in the wild is probably a matter of opinion. It is true that the experimental birds were started on the different diets at sub-average weights, but wild birds may be reduced naturally to as low and lower average weights (Hamerstrom, unpubl.); what if they then have nothing but browse to eat? A comparison of weather conditions in the pens and in the wild does not weaken the argument, as the experimental birds had a slight advantage in this respect, since temperature alone was not important: they had protection against the wind, never found their food unavailable because of snow, and could always feed with a minimum of effort and exposure.

The question hinges upon whether or not captivity so upset the birds that they were unable to maintain weight on a diet which would be adequate for birds without that disadvantage. We cannot be certain.

Combine the experimental and observational approaches, however, and the answer seems to be quite plain: browse alone will not carry Prairie Chickens through the winter. Small numbers may be able to supplement a browse diet with an uncertain supply of weed seeds, but to have Prairie Chickens in quantity in the North Central States, winter grains are necessary.

## Experimental Diets: Incidental Notes

A few incidental points seem worth reporting. Catkins of white and river birch and hazel, and the fruits of smooth sumac, were eaten much more than were buds of any kind. River birch catkins were eaten as readily as those of white birch, although neither Schmidt (1936) nor the Hamerstroms have seen river birch eaten in the wild. Rose hips were eaten freely in 1939, but not particularly so in 1940. The birds on browse alone ate much more browse than those on browse plus grains; the latter ate rather little browse. Birds on browse plus grains ate more grains than those fed grains only. Table 3 lists the grain consumption during the 1940 experiment.

Hopkins calculated the grain consumption in 1939 at about 1½ ounces per bird per day, with corn generally, buckwheat sometimes, as first choice, and wheat third. During both years grain consumption in the pens was about half of Hawkins' (1937) estimate for wild Prairie Chickens. Oats, barley, and rye were not eaten at all in 1939, and were discontinued after the second week.

The figures in Table 3 seem to give clear orders of preference among the different kinds of grain. Corn was always first choice, buckwheat was second eleven times out of twelve, the others shifted about somewhat in order of consumption. Hamerstrom is convinced that no such

TABLE 3

Consumption of Grains, in Ounces: 1940

| Lot | No. birds | No. days | Yel. corn | Buck-wheat | Wheat | Soy beans | Rye | Barley | Oats | Oz. grain per bird per day | Oz. grit per bird per day |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Db | 7 | 15 | 125 | 8 | 17 | | | | | 1.4 | |
| E | 8 | 45 | 427 | 68 | 16 | 10 | 10 | 5 | 1 | 1.5 | 0.04 |
| Aver-age | 7.5 | | | | | | | | | 1.5 | |

general preference exists in the wild. He has seen wild packs alternate between adjoining corn and buckwheat fields with a clear preference for buckwheat through most of a winter; others feeding on soybeans and refusing corn thrown on the ground for weeks at a time, then suddenly switching to corn for a few days; and still others alternating between corn and ragweed when both were equally available and in fields side by side. These shifts, with the possible exception of that from ragweed to grain, seemed not to be correlated with weather conditions; more significant, some packs preferred one grain at the very time that others would have nothing but another. While some packs were eating corn, others refused corn for buckwheat, and others refused corn for soybeans.

## Discussion

The foregoing data on food habits and food requirements stand up well enough as individual facts, but they seem to integrate poorly. For all that these things may be true, the Prairie Chicken is still a grouse, and may well be expected to feed as the others of the family do. Why such extravagant behavior?

It is extremely unlikely that the Prairie Chicken developed as a species along with the development of primitive cultivation. Aside from taxonomic grounds, the food habits of the other two subspecies point in the opposite direction. Gross (1928) and Forbush (1916: 386, 393) say that the Heath Hen ate grains, but Gross (1928: 550) says further " . . . in the winter months acorns, seeds, and certain berries found in abundance throughout the present range of the Heath Hen provide the birds with a livelihood. A comparatively small amount of snow falls on Martha's Vineyard, hence it is an exceptional winter when these birds are unable to secure sufficient food from native plants."

Lehmann (1939 and MS) has found that cultivated crops are not necessary to the Attwater Prairie Chicken (*T. c. attwateri*), and are but little taken. Further, according to Bogardus (1874: 73), Prairie Chickens in Illinois did not recognize corn as a food until several years after its introduction.

Perhaps on their original range and under original conditions Prairie Chickens subsisted on the typical grouse regimen of low concentrate foods. If so, there is no need to look further for an all-important native high-concentrate, such as acorns (Grange, 1939), "acorns or some legume" (Schmidt, 1936), or *Sylphium* (Hawkins, 1937). If so again, the importance of grains in the winter diet of chickens on their acquired northern range may be looked at in another light: the fact that they were adaptable enough to alter their type of feeding has made it possible for them to extend their range so far north of their original limits.

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